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Effects of Foreign Presence in a Transition Economy: Regional and Industry-Wide Investments and Firm-Level Exports in Ukrainian Manufacturing[*]

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We investigate the effects of regional and industry–wide foreign presence and foreign direct investment (FDI) on export volumes of Ukrainian manufacturing firms using unpublished panel data from 1996–2000. Foreign presence through FDI may have negative competition effects on domestic firms' performance while, at the same time, domestic firms' productivity may be increased by technology transfer or through training and demonstration effects. From a Cournot competition model including negative competition and positive technology-spillover effects, we derive the hypotheses that foreign presence and foreign investment might positively affect domestic firms' output and exports. Our estimation results support these hypotheses and suggest in particular that large firms and durable–goods producers benefit most from foreign presence and investments.

Keywords: transition, foreign direct investment, spillovers, firm performance.

JEL classification: F14, F23, L60

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1 Introduction

Foreign direct investment (FDI) is a general element in today's global economy and in particular for those countries in transition to market economies.[1] This is also true for Ukraine, the second-largest economy of the former Soviet Union and a direct neighbor of the European Union, comparing to France both in terms of size and population. The research presented here focuses on FDI in Ukrainian manufacturing.

In 2002, Procter & Gamble established a distribution center in Lviv in Western Ukraine. At the time, it was the first distribution center of an international enterprise in Ukraine and the second of its kind in Eastern Europe. In the following year, Procter & Gamble announced plans to close one of its factories in the United Kingdom and move production of Tampax® tampons to Kyiv, Ukraine and Budapest, Hungary.[2] In the meantime, Procter & Gamble has become just one of many foreign firms to successfully penetrate the Ukrainian market. However, several questions arise: What has happened to Ukrainian companies in the same industry? Have other firms in the same region been affected? Do domestic firms profit from new technologies introduced by foreign firms such as Procter & Gamble, or do they simply exit the market, unable to compete?

We address these questions by utilizing a large, five-year panel of Ukrainian manufacturing firms.[3] Our analysis is based on a few main concepts concerning the transfer mechanisms and the possible effects of foreign presence in a domestic market. In the case of foreign direct investment in building a new plant or by acquisition of a pre-existing domestic firm, foreign investors may introduce their own technology, business practices, and labor force.

[1]For a general overviews of recent developments, see, e.g. Markusen (2002); UNCTAD (2000) provides a focus on global cross-border mergers; Moran (1998) reviews FDI in developing and transition economies; Dyker (1999) focuses on FDI and technology transfer in the former Soviet Union.

[2] See, e.g., http://www.ukraineinfo.us/business/investment.html.

The same investment activities also "spill over" within the same industry or region and lead to indirect effects on other domestic firms also within that same industry or region. Competitors may be negatively affected by foreign firms' market shares, while at the same time being positively affected by opportunities to copy production processes or product designs from them.

While inward FDI is generally associated with higher domestic productivity[4], the evidence on presence and direction of indirect effects is rather mixed. Testing for marginal spillovers from FDI in Romania, Altomonte and Pennings (2005) analyze a panel of 10,650 firms for the period 1995 to 2001 and find that domestic firms' total factor productivity reacts positively on initial foreign investment while being affected negatively later on.

The *competition effect* is found to have both positive and negative impacts. Positive spillovers are found in Canadian and Australian manufacturing industries (Caves, 1974), and in Indonesian banks (Cho, 1990). However, negative effects are observed in Aitken and Harrison (1999) for a panel of 4,000 Venezuelan firms between 1976 and 1989. Higher FDI is associated with lower productivity for completely domestically-owned firms in the same industry. Negative effects are also observed in Belgian manufacturing industries (De Backer and Sleuwagen, 2003). Using firm–level panel data from Poland, Bulgaria and Romania, Konings (2001) finds that only in Poland do foreign firms outperform domestic firms, while there is evidence of FDI giving rise to negative spillovers (as is the case of Bulgaria and Romania) or no spillovers (as in Poland). He concludes that during earlier stages of transition (e.g. for Bulgaria and Romania) the positive technology spillover effect seems to be dominated by the negative competition effect of FDI, as inefficient domestic firms inevitably lose market share

[3] So far, very little empirical research about Ukrainian manufacturing has been forwarded in the literature. For some of this, see e.g. Aleksynska et al. (2003) and Lutz and Talavera (2005).

[4] This is demonstrated, e.g., by Bitzer/Görg (2005) for 10 industries in 17 OECD countries and data covering the period 1973 to 2000.

to foreign firms. In later stages of development (as we see in Poland), when domestic firms have started restructuring and market competition has increased, the competition effect seems to disappear. The *technology transfer* channel has received some justification both theoretically (Blomström, 1987; Blomström and Kokko, 1997) and empirically for the case of Indonesia (Sjöholm, 1999).[5] However, Blomström and Kokko (2003) present evidence that technological spillovers are not an invariate consequence of FDI. Other highly convincing contrary evidence has also been presented. Aitken and Harrison (1999) introduce controls for local technology spillovers by including foreign-employment shares in per industry and per region analyses. They argue that previous studies found unambiguously positive effects for local technology spillovers and so overstated positive spillovers because multinationals are likely to invest in more productive sectors and firms. When this bias is addressed by including proxies for exogenous productivity differences between regions (i.e. real wage of skilled workers, price of energy), no evidence for technology spillovers to domestic firms is found. Furthermore, foreign presence within industrial sectors does not have any significant effects on productivity of Czech manufacturing firms (Kinoshita, 2000) or similar firms in the Wroclaw region, Poland (Hardy, 1998).

If a multinational firm establishes new business relations between upstream suppliers and downstream firms, this can establish *backward and forward linkages* leading to the transfer or spillover of technological know-how.[6] Within higher aggregated industrial data as we

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[5] Some preliminary evidence for Russia has also been presented in working papers by Ponomareva (2000) and by Yudaeva et al. (2001).

[6] FDI–induced *backward and forward linkages* can push industrial development, especially with regard to the formation of small businesses. FDI creates backward linkages, for instance, by foreign firms purchasing local services and subcontracting with domestic firms. Javorcik (2004) and Javorcik/Saggi/Spatareanu (2004) analyze panels of Lithuanian firms (for the years 1996 to 2000) and Romanian firms (for the years 1998 to 2000), respectively, and find evidence for backward linkages. Observing small businesses along the border of Mexico, it is found that the linkage approach reasonably describes the development of small business employment (Brown, 2002). On the other hand, there is little evidence for both backward and forward linkages for the German–owned manufacturing sector in the northeast of England (Kirchner, 2000) and for Korean FDI in Southeast Asia, (Lee, 1994).

present it[7], these linkages may show up as intra-industry effects that are indistinguishable from horizontal technology transfer effects. Therefore, when we refer in our model and in the interpretation of the data to positive spillovers due to technology transfer, we cannot rule out that any effects we find are partly due to backward and forward linkages.[8]

Other possible spillover channels affecting domestic firms' cost functions may include *training effects*[9] or *demonstration effects*[10]. In addition, domestic firms' *proximity to multinational enterprises*[11] *or to other exporters*[12] may provide another source of productivity enhancement. Lastly, highly productive firms may be a priori more likely to export: *productivity leads to exports*[13]. Our data do not allow us to distinguish between all of these different sources of productivity improvements, but we are able to estimate aggregated effects. In summary, based on previous literature discussed we assume that there are two counteracting effects on a domestic firm's incentive to produce or export. However, our literature discussion does not allow us to draw a clear conclusion about which one of these two effects at work will be dominant. In order to answer this question, we present a simple oligopolistic model with technological spillover effects and derive the hypotheses that increases in foreign investments or increases in the number of foreign firms present will indeed increase domestic firms' ex-

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[7] Industries in our data set are classified into 16 categories on the two-digit level; see Table 4.

[8] As argued in Javorcik/Saggi/Spatareanu (2004), many firm-level studies cast doubt on the existence of horizontal spillovers in transition countries while those spillovers may be more likely in developed countries.

[9] Training spillovers result from foreign firms investing in human capital. In Mexico, many at the managerial level start their careers in foreign companies and are later employed in domestic firms (Blomström, 1989). Moreover, domestic firms are afraid of losing their market shares and they too invest in training their workers and managerial personnel (Kinoshita, 1998). Generally, human capital is an important determinant of the distribution of foreign direct investment in developing countries (Noorbakhsh et al., 2001).

[10] Demonstration effects are potentially very important for many countries and industries according to Blomström and Kokko (1998). De Backer and Sleuwagen (2003) present an analysis of Belgian manufacturing firms and show evidence of positive long-term demonstration effects.

[11] See Javorcik (2004) for Lithuanian manufacturing. Aitken, Hanson and Harrison (1997), analyzing a panel of 2,100 Mexican manufacturing firms between 1986 and 1990, present evidence that the probability of a domestic firm being an exporter is positively correlated with its proximity to multinational firms.

[12] Proximity of domestic firms to other exporters has been shown to have a positive effect on the probability to export for firms in Colombia, Mexico and Morocco (Clerides, Lach and Tybout, 1998).

[13] Bernard and Jensen (1999, 2004) present evidence that productivity leads to exports by analyzing an unbalanced panel of about 60,000 US firms each year from 1984 to 1992.

ports if technological spillover effects are large enough. Our dataset consists of an unbalanced panel of all manufacturing firms in Ukraine over the 1996–2000 period. On average, we have annual data on 8,500 manufacturers including 2,400 exporters. Our estimation results support the model hypotheses for Ukrainian manufacturing and suggest in particular that large firms and durable–goods producers benefit most from foreign presence and investments.

The following section presents the Cournot competition model. The data are described in section 3, while section 4 discusses the empirical results. Finally, Section 5 concludes with a summary and discussion.

2 Augmented Oligopolistic Competition Model

2.1 The Model

We present an oligopolistic-competition model with spillover effects in the cost functions. Due to cost-reducing spillovers, domestic firms will increase production and export levels in response to increased foreign presence in their industry or their region of residence.[14]

In the home country economy, there are n_H domestic firms and n_F foreign-owned firms[15]; both foreign and domestic firms offer their products in the home market as well as in the foreign market. There are no trade costs and firms produce heterogeneous goods and compete in quantities. We assume that the inverse demand, P_i, for a good produced by either a domestic or a foreign firm *i (i = H, F)* in market *k (k = H, F)* is of the form:

$$P_i = \alpha - (\beta - \gamma)q_i - \gamma Q \tag{1}$$

In this specification, total demand in each of the two identical markets is $Q = n_H\, q_H + n_F\, q_F$, where q_H is a representative domestic firm's output per market and q_F is a representative for-

[14]c.f. models by Siotis (1999), Leahy and Pavelin (2002), Ferrett (2005).

[15] Both domestic- and foreign-owned firms are located in the home country only. This could be the result of high labor costs in the foreign country or other locational disadvantages.

eign firm's output per market.[16] Marginal production cost of firm i is denoted as c_i. Every firm faces variable costs, but also spends j_i for R&D investment. Investment j_i reduces variable cost by $\delta_i \sqrt{j_i}$.

The firm cannot fully protect its stock of knowledge, and so, as a result, the investment spills over to other firms. We denote θ_H as a spillover coefficient for funds invested by (n_H - 1) other domestic firms and ψ_H as a spillover coefficient for funds invested by n_F foreign firms (FDI). We assume that the more other firms invest, the lower marginal costs of the representative domestic firm are. Spillover parameters for foreign firms, θ_F and ψ_F are defined analogously.

$$c_H = w_H - \delta_H \sqrt{j_H} - \theta_H (n_H - 1) j_H - \psi_H n_F j_F \quad (2)$$

$$c_F = w_F - \delta_F \sqrt{j_F} - \theta_F (n_F - 1) j_F - \psi_F n_H j_H \quad (3)$$

Representative domestic and foreign firms maximize their profits per market:

$$\max_{q_i} P_i (q_i - c_i) \quad (4)$$

Assuming symmetry we receive the following first order conditions:

$$\alpha - w_H + \delta_H \sqrt{j_H} - 2(\beta + (n_H - 1)\gamma) q_H - \gamma n_F q_F + \theta_H (n_H - 1) j_H - \psi_H n_F j_F = 0 \quad (5)$$

$$\alpha - w_F + \delta_F \sqrt{j_F} - 2(\beta + (n_F - 1)\gamma) q_F - \gamma n_H q_H + \theta_F (n_F - 1) j_F - \psi_F n_H j_H = 0 \quad (6)$$

Solving this system we receive the optimal export[17] quantity, q_H, for the domestic firm:

$$q_H = \frac{k_{2H} + k_{3H} j_H + k_{4H} j_F + k_{5H} \sqrt{j_H} + k_{6H} \sqrt{j_F}}{k_{1H}} \quad (7)$$

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[16] Symmetry among domestic firms and symmetry among foreign firms are assumed. However, the technology available to domestic firms is different from that available to foreign firms.

[17] Due to symmetry between the foreign and domestic markets, domestic sales are equal to exports and total production is 2 q_H. Without the symmetry assumption, the export/output ratio changes, but the qualitative results of foreign entry and/or FDI remain unaffected.

where $k_{1H} = 2(\beta - \gamma)(2\beta + \gamma(n_H + n_F - 2))$, $k_{2H} = 2(\alpha - w_H)(\beta - \gamma) - n_F \gamma (w_H - w_F)$, $k_{3H} = 2(\beta - \gamma)\,\theta_H (n_H - 1) + \gamma\,\theta_H n_F (n_H - 1) - \gamma\,\psi_F n_F n_H$, $k_{4H} = \gamma n_F^2 (\psi_H - \theta_F) + 2n_F \psi_H (\beta - \gamma) + \gamma n_F \theta_F$, $k_{5H} = 2\,\delta_H (\beta - \gamma) + \gamma\,\delta_H n_F$, $k_{6H} = \gamma\,\delta_F n_F$.

This equation relates presence of foreign firms in the industry to the export volume of the representative domestic firm. Taking the derivatives of equation (7) with respect to the number of foreign firms in the industry and the level of investment by foreign firms, we receive:

$$\frac{\partial q_H}{\partial j_F} = \frac{1}{k_{1H}}\left(k_{4H} + k_{6H}\frac{1}{2\sqrt{j_F}}\right) = \frac{n_F}{4\sqrt{j_F}}\frac{(4\sqrt{j_F}\beta\psi_H - \gamma(\delta_F + 2\sqrt{j_F}(\theta_F(n_F-1) - \psi_H(n_F-2)))}{(\beta-\gamma)(2\beta+\gamma(n_H+n_F-2))} \tag{8}$$

$$\begin{aligned}\frac{\partial q_H}{\partial n_F} &= \frac{1}{k_{1H}}\left(-q_H\frac{\partial k_{1H}}{\partial n_F} + \frac{\partial k_{2H}}{\partial n_F} + j_H\frac{\partial k_{3H}}{\partial n_F} + j_F\frac{\partial k_{4H}}{\partial n_F} + \sqrt{j_H}\frac{\partial k_{5H}}{\partial n_F} + \sqrt{j_F}\frac{\partial k_{6H}}{\partial n_F}\right) = \\ &\frac{1}{2(\beta-\gamma)(2\beta+\gamma(n_H+n_F-2))}(-q_H 2(\beta-\gamma) - \gamma(w_H - w_F) + \\ &+ j_H\gamma(\theta_H(n_H-1) - \psi_F n_H) + j_F 2(n_F(\psi_H - \theta_F) + \psi_H(\beta-\gamma)) + \sqrt{j_H}\gamma\delta_H + \sqrt{j_F}\gamma\delta_F)\end{aligned} \tag{9}$$

Entry of an additional foreign firm or increases in investments by foreign firms will have unambiguously positive effects as long as γ is not too close to β and $\{\psi_H, \theta_H\}$ are large enough relative to $\{\theta_F, \psi_F\}$.[18] This means domestic firms will increase output and thus exports when their product is not too close a substitute to foreign products and the cost-reducing effect from spillovers for domestic firms is not too small relative to spillovers that foreign firms receive themselves.[19]

[18] See Appendix 2 for conditions on positive effects.

[19] This is more likely to be the case the larger the technology gap between domestic and foreign firms. See, e.g., Sjöholm (1999) for the case of Indonesian Manufacturing.

2.2 Model Parameterization

Equation (7) is not linear in n_F, n_H, j_H, j_F, w_H or w_F. However, after a linear transformation and taking logarithms, we can express the relation from equation (7) in the following simplified form:

$$\hat{q}_{H,it} = \phi_0 + \phi_{n_F}\hat{n}_{F,it} + \phi_{n_H}\hat{n}_{H,it} + \phi_{j_H}\hat{j}_{H,it} + \phi_{j_F}\hat{j}_{F,it} + \phi_w \hat{w}_{it} \tag{10}$$

where ^ denotes that all variables are now in (natural) logarithms. For a particular domestic firm i at time t, the variables n and j are numbers of firms and investment per firm, respectively, in the particular industry. Parameterizing $\hat{w}_{it}$ as a linear function of regional spillovers, scale variables and export volume at the previous period[20], we receive:

$$\begin{aligned}\hat{q}_{H,it} = {} & \phi_{0t} + \phi_{n_F}\hat{n}_{F,it} + \phi_{n_H}\hat{n}_{H,it} + \phi_{j_H}\hat{j}_{H,it} + \phi_{j_F}\hat{j}_{F,it} + \phi_{sc} \\ & + \phi_w(\phi_{wi} + \phi_{x_F}\hat{x}_{F,it} + \phi_{x_H}\hat{x}_{H,it} + \phi_{y_F}\hat{y}_{F,it} + \phi_{y_H}\hat{y}_{H,it} + \phi_q\hat{q}_{it-1} + \phi_{SC}Scale_{it} + \varepsilon_{it})\end{aligned} \tag{11}$$

where ϕ_{wi} is the firm–specific level of marginal cost (the firm fixed effect), $Scale_{it}$ is the size of the firm (proxied by the number of workers), $\hat{x}_{F,it}$ is the number of foreign firms in the region, $\hat{x}_{H,it}$ is the number of domestic firms in the region, $\hat{y}_{F,it}$ is the volume of FDI received by a single firm in the region, $\hat{y}_{H,it}$ is the volume of domestic investment received by a firm in the region, $\hat{q}_{it-1}$ is the volume of exports in the previous period, and ε_{it} is an error term.

Let J_H be the total volume of domestic investment in the industry, J_F the total volume of foreign investment in the industry, Y_H the total volume of domestic investment in the region, and Y_F the volume of foreign investment in the region. Since we assume symmetry,

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[20]We parameterize $\hat{w}_{it}$ because we do not have any data on firms' costs. This parameterization can be justified as follows. Every firm has its specific marginal cost, which depends not only on firm characteristics but also on the firm's environment. Marginal cost is higher if the number of potential customers is low or transaction costs are high. Thus, if a firm is surrounded by a richer variety of other firms who also invest in R&D or have some experience of selling the product, then its costs will be lower.

we can use the approximate relationships $\hat{y}_i \approx \hat{Y}_i - \hat{x}_i$ and $\hat{j}_i \approx \hat{J}_i - \hat{n}_i$, i = H, F, to replace individual investment levels. This leads to our final model specification[21]:

$$\begin{aligned}\hat{q}_{it} &= \xi_{0t} + \xi_{0i} \\ &+\xi_{n_F}\hat{n}_{F,it} + \xi_{n_H}\hat{n}_{H,it} + \xi_{J_F}\hat{J}_{F,it} + \xi_{J_H}\hat{J}_{H,it} \\ &+\xi_{x_F}\hat{x}_{F,it} + \xi_{x_H}\hat{x}_{H,it} + \xi_{Y_F}\hat{Y}_{F,it} + \xi_{Y_H}\hat{Y}_{H,it} \\ &+\xi_q\hat{q}_{i,t-1} + \xi_{sc}Scale_{it} + \phi_w\varepsilon_{it}\end{aligned} \tag{12}$$

where $\xi_{0t} = \phi_{0t}$, $\xi_{0i} = \phi_w\phi_{0i}$, $\xi_{n_F} = (\phi_{n_F} - \phi_{j_F})$, $\xi_{n_H} = (\phi_{n_H} - \phi_{j_H})$, $\xi_{J_F} = \phi_{j_F}$, $\xi_{J_H} = \phi_{j_H}$, $\xi_{x_F} = \phi_w(\phi_{x_F} - \phi_{y_F})$, $\xi_{x_H} = \phi_w(\phi_{x_H} - \phi_{y_H})$, $\xi_{Y_F} = \phi_w\phi_{y_F}$, $\xi_{Y_H} = \phi_w\phi_{y_H}$, $\xi_{Sc} = \phi_w\phi_{Sc}$, and $\xi_q = \phi_w\phi_q$.

Our theoretical model leads us to expect in particular positive signs on ξ_{n_F} and ξ_{J_F} since positive technology spillover effects are supposed to outweigh negative competition effects. Given our data, however, we can only observe the net effects of these counteracting forces. Spillover effects of foreign presence due to forward-backward linkages may be captured through our regional spillover variables[22], i.e. we would expect positive signs on ξ_{x_F} and ξ_{Y_F}. In addition, these parameters may also pick up some training and demonstration effects. Unfortunately, identifying these latter effects would require additional firm-specific data, such as labor turnover, etc., which was not recorded in the panel.

3 Data description

We used an unpublished dataset of Ukrainian manufacturing firms to create an unbalanced firm panel for the years 1996 to 2000.[23] The panel consists on a yearly average of 8,500

[21] See also Bernar and Bradford (1999).

[22] Foreign-owned firms usually require high quality input materials, which in turn leads to improvements of local material supplies. This is the case e.g. for McDonalds' relationship with its local suppliers Chumak, Galakton, Slavyansky Dom and the Vinnytsya meat processing plant (see http://www.artukraine.com/commercial/mcdonalds2.htm).

[23] The data were obtained from the Economics Education and Research Consortium (EERC); the original source is the Statistical Committee of Ukraine.

firms .[24] Of these firms, 2,400 export their products.[25] The firms are classified by a two–digit Industrial Classification and represent sixteen industrial sectors: energy, fuel, coal, ferrous metallurgy, non-ferrous metallurgy, chemical, oil–chemicals, machinery, forest, construction materials, light, food, flavor, microbiology, medical equipment, printing and other. Firms are localized over twenty-seven geographical regions, covering the Crimean Autonomous Republic, twenty-four "oblasts", and the cities Kyiv and Sevastopil. We utilize EERC's data items "volumes of export", $Export$ in our annotation, and "number of workers", here called $Labor$.[26] Moreover, as a proxy for the number of firms in the industry or in the region we use the number of firms in our dataset.[27]

Several sample selection criteria are applied to the original sample. First, all negative values for volume of export and number of workers variables in the sample are dropped. Secondly, the firms with a volume of exports higher than the 99th percentile or lower than the 1st percentile are also excluded. We prefer to use the screened data to reduce the potential impact of outliers upon the parameter estimates. Table 1 presents descriptive statistics for firm-specific variables.

In order to test the effects of spillovers on firms facing similar characteristics, the dataset is split into two categories: large and small firms. A firm is considered to be „large" if its number of workers is above the 75th percentile by year. If a firm's number of workers is below the 25th percentile by year, then it is classified as „small".[28] A two–sample paired *t*–

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[24] Because of data restrictions we only investigate exporting firms. We attempted estimations with sales as a dependent variable but received strong misspecification for these models.

[25] In our five-year panel, we have a total of 12,112 export observations and a yearly average of 2,422 observations. Export volumes are equal to zero for 40 of these observations. Export volumes for at least four (three) years are reported for 43% (57%) of the firms in the panel. Average export-output and export-sales shares were between 20% and 70% for the years 1996-1998.

[26] *Export* is measured in 1,000s of USD.

[27] Supposedly, the data cover all manufacturing production in Ukraine. However, some data might have been lost or withheld.

[28] A similar categorization is done by Baum et al. (2003). To check for potential sample selection issues we created subsamples based on presample values. The results follow the patterns of the reported ones.

test is used to test for the equality of means, and we identify significant differences in the behavior of large and small firms.

Moreover, we investigate the spillover effect for „durable“ and „non–durable“ goods producers. This classification is based on the dichotomy proposed by Sharpe (1994): First, we find the correlation between sales and nominal GNP. Second, firms with an average correlation higher than the 60^{th} percentile are considered as durable goods producers, while firms with correlation on average lower than the 40^{th} percentile are denoted as non–durable goods producers.

In order to control for agglomeration effects, we consider a subsample we will call „urban“ firms located in regions where there are cities with populations of one million or more.[29] Compared to the rest of the country's average, all these regions are characterized by much higher volumes of FDI and a higher number of manufacturing firms receiving FDI. For example, on average 112 such firms are located in the Dnipropetrovsk region, which is more than the total of FDI firms in the regions Kherson, Chernivtsi, Chernigiv, Kirovograd, and Volyn together. „Non-urban“ firms are located in the remaining regions and will likely demonstrate the effects of non-agglomeration.

From the data distribution by industry (Table 4), we see that some industries are characterized by high levels of exports but low levels of FDI (e.g. non-ferrous metallurgy) while others are characterized by high levels of both exports *and* FDI (e.g. ferrous metallurgy).

4 Regional and Industry–Wide Spillover Effects

We estimated Equation (11) for all firms and several splits of firms, using ordinary least square, fixed-effect, one-step Generalized Method of Moments (GMM), and two-step GMM

[29] "Urban" firms are located in Lviv, Odesa, Kharkiv, Donetsk, Dnipropertrovsk, Zaporizhzhia regions and Kyiv city.

estimation.[30] The results are given in Tables 5-8. In all estimations, the dependent variable is the logarithm of exports. The independent variables are number of workers; the number of foreign/home firms in the region; the number of foreign/home firms in the industry; the logarithm of investment of foreign/home firms in the region; the logarithm of investment of foreign/home firms in the industry and the lagged level of the logarithm of export.

Table 5, column (1) in the Appendix describes the results for OLS estimations. These are ex-ante biased and, consequently, only provided for comparison.[31] Fixed–effect estimation results correspond better to our theoretical anticipations (Table 5, column 2). They provide some evidence for positive regional spillovers from FDI, namely that there is a significantly positive impact of foreign presence on exports of firms in that region. This suggests significant linkage effects. There are also significant effects of the number of domestic firms on the volume of exports in the same region (positive) and industry (negative).

Columns (3) and (4) of Table 5 present dynamic panel estimations.[32] The models are estimated using an orthogonal transformation instrumented by all available moment restrictions starting from $(t-1)$.[33] Similarly, Tables 6–8 describe the results of testing our theoretical model using dynamic panel estimators for three different splits: durable–goods producers and nondurable–goods producers; small firms and large firms; urban firms and non-urban firms. Columns (1) and (3) of each table represent models using one–step estimation, while

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31 OLS results are upwards biased while fixed-effect model results are downward biased. The coefficient for the lagged value of the log of exports for the GMM estimation is between OLS and WITHIN estimators. This supports the appropriateness of GMM usage. For details, see Bond (2002).

32 The specifications include firm fixed effects, time dummies, and industry dummies. Adding regional dummies, however, would lead to multicollinearity in our specifications.

33 The orthogonal transformation uses

$$x^*_{it} = (x_{it} - \frac{x_{i(t+1)} + \ldots + x_{iT}}{T-t})(\frac{T-t}{T-t-1})^{1/2}$$

where the transformed variable does not depend on its lagged values. If we use first differences instead of an orthogonal transformation, we will have to instrument with moment restrictions starting from $t-2$ which will lead to dropping an additional 20% of the available data., (Arellano and Bover, 1995).

columns (2) and (4) describe two–step estimation.

The correctness of the respective model specification is checked using the Sargan test. We computed the Sargan test for each two–step GMM model, and we do not receive rejection for overidentifying restrictions.[34] In the analysis for the „all firms“ dataset (Table 5, columns (3) and (4)), we receive evidence for positive industry spillover effects. For instance, the Entry of a foreign firm in an industry increases the exports of a company in that industry by roughly1.2 %. Similarly, Entry of a foreign firm in a particular region raises exports of domestic firms in that region by about 0.6 %. There is also significant evidence for regional spillovers from domestic investment.[35]

One interesting contrast is observed for the „durable“ and „non–durable“ goods producers split as described in Table 6. Results for non–durable firms demonstrate no significant spillover effects from foreign firms at all. On the other hand, the findings show a much stronger trend for durable–goods producers: entry of one foreign firm into the industry increases the level of exports of a domestic firm in that industry by 1.3%, while Entry of one foreign firm in the region increases the level of exports of a domestic firm in the same region by about 0.8 %.

Comparing the results for „small“ and „large“ firms (Table 7), one can see that the number of foreign firms in the region does not seem to have any effect on small domestic firms' exports, while there are highly significant (at the 1% level) regional spillovers for large firms. An increase in the number of foreign firms in the region by one increases a domestic firm's exports by about 1.3 %. Concerning industry spillovers, the number of foreign firms

[34]Note: we do not report Sargan test results for one–step GMM results. The Sargan test has an asymptotic chi–squared distribution only in the case of homoscedastic error terms. Our dataset is very heteroscedastic so we receive rejection of overidentifying restrictions in most cases. Arellano and Bond (1991) also mention that the Sargan test on the one–step estimation often leads to rejection of the null hypothesis indicating that the overidentifying restrictions are valid.

[35] We also reestimated the models in Table 5 using a smaller data set including only firms with at least four observations. The results appear to be robust with respect to foreign presence.

has a significantly positive effect (at the 5 % level) on exports of large firms only. The effect of a domestic firms' presence in the region is positive and significant (at 1%) for large firms only: A one unit rise in the number of domestic firms in the region raises domestic firms' exports by almost 0.8 %. Effects of the number of domestic firms in the industry on large domestic firms' levels of exports are slightly negative. Interestingly, there is a negative coefficient on the lagged dependent variable for small firms and positive for large firms. This could be explained by occasional export opportunities faced by former ones and more persistent by firms with higher number of employees.

The results for „urban" and „non-urban" firms (Table 8) are also quite striking: Firms in both categories are significantly affected by foreign firms' activities. Entry of one foreign firm in the region or in the industry leads to an increase in the level of exports by one to two percent. Similarly, both categories are negatively affected by more domestic competition in the industry. In contrast, the number of domestic firms in the region has a significant effect on volumes of export for "non-urban" firms only. Nevertheless, spillover effects are generally larger (about double) for "urban" firms.

In summary, we find general support for the model's predictions on the effect of industry–wide FDI spillovers for the „all firms" data set. For different categories of firms, we receive support for the model's predictions to varying degrees. The results are stronger for large firms, "urban" firms and durable-goods producers. Large firms can more easily adjust the quality of their production to meet the requirements of foreign firms in the region or even export their products. Similarly, Sinani and Meyer (2002) argue that large firms have more resources to invest in absorbing new technology of foreign firms or to attract better-qualified labor in order to cope with increased competition from foreign firms. Interestingly, Aitken and Harrison (1999) arrive at quite different results. In a study of 4,000 Venezuelan firms, they concluded that only small firms'[36] productivity significantly benefits from FDI, while there is no significant effect on large firms. While we might have expected to see an advantage for firms located in urban areas, our data does not offer any evidence for that. Finally, spillover effects might be more significant for durable–goods producers because this type of production requires higher level of backward and forward linkages within the same industry.

5 Conclusions

We examined the effects of industry–wide and region–wide spillovers on the optimal level of exports. Based on a simple oligopolistic competition model augmented with spillover effects, we hypothesized that a domestic manufacturing firm's performance, measured by the volume of exports, responds both to industry–wide and region–wide spillover effects. If technological spillover effects are present and large enough, then increased foreign presence should increase the volume of exports of a representative firm as well. To test this hypothesis we utilized a five-year panel-dataset of Ukrainian manufacturing firms including on a yearly average about 2,400 exporters.

Our empirical findings broadly support the notion that foreign direct investments do benefit firms operating in Ukraine. Positive effects are found to be stronger for larger firms and for durable-goods producers. However, since our data did not allow us to distinguish individual firms by ownership, we cannot distinguish direct and indirect effects of FDI. Future research will concentrate on collecting such information and reexamining our data in order to isolate indirect effects indicating spillovers. Similar to the results for a much smaller number of Ukrainian firms presented in Lutz and Talavera (2005), we expect to be able to identify both significant direct and significant spillover effects. Given the high level of aggregation of our data, this would likely also include vertical spillovers due to backwards or forwards link-

[36] Defined as firms with less than 50 workers.

ages. The task to separate vertical from horizontal spillovers, however, would require more highly disaggregated data. The presence of vertical spillovers due to backwards or forwards linkages could also explain that positive effects are stronger for durable–goods producers, since production of a durable good is likely to require a larger number of backward and forward linkages within both the same industry and region. Keeping data problems mentioned above in mind, our results may nevertheless suggest that measures promoting FDI, such as free-trade zones or tax privileges to foreign investors may indeed benefit Ukrainian firms.

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Appendix 1: Variables used in the paper

- EERC database
  - Volume of Export
  - Number of domestic firms in industry or region
- http://upop.irex.ru/eco.asp
  - Nominal Gross Domestic Product
  - Producer Price Index (PPI)
- Ukrainian statistic yearbooks, 1996-2000
  - Volume of domestic investment in industry and region
  - Volume of foreign investment in industry and region
  - Number of manufacturing firms with FDI in industry and region

Appendix 2: Conditions for positive effects of foreign presence

$$\frac{\partial q_H}{\partial j_F} > 0 iff \psi_H > \frac{\frac{\delta_F}{\sqrt{j_F}} + 2\theta_F(n_F - 1)}{4\beta + 2\gamma(n_F - 2)} \tag{A2.1}$$

$$\frac{\partial q_H}{\partial n_F} > 0 iff \psi_H > \frac{2(\beta-\gamma)q_H + \gamma(w_H - w_F) + 2j_F n_F \theta_F - j_H \gamma(\theta_H(n_H - 1) - \psi_F n_H) - \sqrt{j_H}\gamma\delta_H - \sqrt{j_F}\gamma\delta_F}{2j_F(n_F + (\beta - \gamma)} \tag{A2.2}$$

Table 1: Descriptive statistics for all, small and large firms

	μ	*σ*	*p25*	*p50*	*p75*
all					
Exports, 1000 USD	4199.46	18759.46	63.80	321.25	1674.90
Number of workers	776.23	1304.24	180.00	372.00	808.50
F firms in region	91.39	108.25	33.00	52.00	109.00
F firms in industry	167.79	94.91	107.00	178.65	222.82
H firms in industry	1184.95	734.61	531.00	1384.18	1849.00
H firms in region	242.28	130.81	192.00	237.00	314.00
small					
Exports, 1000 USD	741.50	2710.85	30.10	113.10	456.50
Number of workers	113.07	47.11	77.00	116.00	148.00
F firms in region	91.08	106.10	31.00	51.00	112.00
F firms in industry	175.03	104.59	89.00	178.65	224.00
H firms in industry	1273.95	773.83	568.00	1839.00	2009.00
H firms in region	238.13	121.35	190.00	237.00	310.00
large					
Exports, 1000 USD	7109.07	25912.78	82.00	506.65	2912.00
Number of workers	2181.39	2019.02	1090.00	1535.00	2438.00
F firms in region	90.05	108.79	33.00	52.00	105.00
F firms in industry	153.53	84.31	89.00	178.65	215.00
H firms in industry	1049.48	685.27	501.00	1384.18	1839.00
H firms in region	240.31	135.16	190.00	237.00	303.00

Note: (i) p25, p50 and p75 represent the quartiles of the distribution, while σ and μ represent its standard deviation and mean respectively, (ii) F denotes "foreign" and H stands for ``home".

Table 2: Descriptive statistics for durable, non—durable goods producers, urban and non-urban firms.

Variable	μ	σ	p25	p50	p75
durable					
Exports, 1000 USD	4756.43	22099.45	46.65	251.00	1612.25
Number of workers	691.28	1290.19	161.00	316.00	662.00
F firms in region	89.68	110.04	33.00	51.00	104.00
F firms in industry	164.41	92.31	107.00	178.65	222.82
H firms in industry	1140.18	731.79	531.00	1384.18	1849.00
H firms in region	236.13	128.62	190.00	237.00	303.00
non-durable					
Exports, 1000 USD	2782.76	10385.52	78.00	321.50	1297.00
Number of workers	801.15	1197.31	197.00	415.00	910.00
F firms in region	90.51	101.66	34.00	59.00	112.00
F firms in industry	171.02	97.39	89.00	203.00	222.82
H firms in industry	1233.71	737.15	568.00	1404.00	1849.00
H firms in region	250.37	128.50	193.00	243.00	329.00
urban					
Exports, 1000 USD	5491.93	22794.02	76.15	425.70	2161.80
Number of workers	967.40	1638.95	201.00	426.00	1049.00
F firms in region	161.10	138.03	80.00	113.00	160.00
F firms in industry	159.41	95.09	59.00	203.00	222.82
H firms in industry	1133.77	739.53	489.30	1384.18	1848.00
H firms in region	270.61	187.59	240.00	297.00	390.00
non-urban					
Exports, 1000USD	3314.32	15337.29	56.60	265.80	1369.40
Number of workers	635.93	965.35	170.00	345.00	694.00
F firms in region	43.65	33.02	24.00	35.00	51.00
F firms in industry	173.52	94.37	108.00	178.65	222.82
H firms in industry	1220.00	729.21	538.80	1384.18	1849.00
H firms in region	222.88	61.69	187.00	220.00	250.00

Note: (i) p25, p50 and p75 represent the quartiles of the distribution, while σ and μ represent its standard deviation and mean respectively, (ii) F denotes "foreign" and H stands for ``home".

Table 3: Descriptive statistics by region.

Variable	Observa-tions	Export, 1000 USD	Labor	F Firms	FDI, 1000 USD
Crimea	255	4287.36	637.14	43.6	26285.25
Sebastopol	82	543.30	271.11	3.8	2828.23
Vinnitsa	527	3151.69	484.60	28.6	3319.25
Volyn	292	1613.33	600.40	22.2	9275.58
Dnipropetrovsk	702	12978.69	1557.10	111.8	22247.36
Donetsk	886	7182.00	1260.43	101.1	41995.08
Zhytomyr	552	1778.49	602.83	34.8	4762.37
Zakarpattia	610	2800.53	438.86	133.4	13981.86
Zaporizhzhia	485	8983.56	1175.71	46.8	41098.11
Ivano-Frankivsk	396	3563.93	621.58	67.8	4406.80
Kyiv-city	727	3568.15	664.04	468.0	202988.80
Kyiv-region	474	2459.85	495.66	64.8	43715.80
Kirovograd	256	1355.28	532.25	13.6	2551.80
Lugansk	488	6341.76	930.78	35.6	1532.92
Lviv	862	1795.17	598.26	170.0	21168.68
Mykolayiv	216	6575.36	1036.35	41.2	4933.74
Odesa	506	2136.08	433.98	113.6	25498.87
Poltava	463	5325.92	716.66	49.8	40003.81
Rivne	323	1930.70	540.50	23.8	6314.97
Sumy	410	4378.26	889.60	30.0	3702.03
Ternopil	256	1601.48	509.84	31.0	2532.29
Kharkiv	756	2630.41	966.15	72.8	15069.69
Kherson	151	2706.47	1097.91	48.2	6609.32
Khmelnytsky	414	2558.86	659.46	32.8	1675.11
Cherkasy	423	4888.08	605.59	48.2	2514.16
Chernivtsi	384	3115.57	563.14	17.2	5052.36
Chernigiv	218	1853.71	504.19	18.8	4379.49

Note: All variables are averaged over the period 1996-2000 for each region.

Table 4: Descriptive statistics by industry.

Variable	Observa-tions	Export, 1000 USD	Labor	F Firms	FDI
Energy	46	1203.42	2794.00	1.8	1944.17
Fuel	96	19364.66	1261.24	15.6	50235.07
Ferrous metallurgy	491	20923.36	2032.58	27.6	34991.29
Non-ferrous metallurgy	105	20593.62	1138.44	14.0	23.45
Chemicals	498	10272.15	1139.57	90.6	8794.23
Oil-Chemicals	103	4431.05	833.66	6.4	6131.91
Metal processing	4237	3304.07	1002.01	242.6	59189.58
Wood and Paper	1308	1258.62	458.67	122.0	9043.57
Construction materials	906	1463.32	608.27	59.8	1276.98
Light	1285	4173.12	617.87	150.4	3517.94
Food	2420	2920.44	380.23	320.6	125075.00
Flavor	193	728.40	205.89	2.8	4.67
Microbiology	43	736.07	345.71	19.4	1316.25
Medical equipment	178	1782.20	567.60	19.8	5056.05
Printing	79	891.11	302.63	28.4	1214.89
Others	126	7849.95	381.95	28.2	1885.76

Note: All variables are averaged over the period 1996-2000 for each industry.

Table 5: OLS, Within and GMM estimations for all firms.

Independent variable	OLS (1)	WITHIN (2)	ONE-STEP (3)	TWO-STEP (4)
Export_{t-1}	0.8888***	-0.0041	0.0803**	0.0516
	(0.0185)	(0.0509)	(0.0363)	(0.0387)
Labor_t	0.0807***	1.0419***	1.0061***	1.0409***
	(0.0249)	(0.1305)	(0.1268)	(0.1345)
F firms in industry_t	0.0037	0.0018	0.0129**	0.0117***
	(0.0031)	(0.0026)	(0.0046)	(0.0040)
F firms in region_t	0.0000	0.0042***	0.0056***	0.0061***
	(0.0003)	(0.0014)	(0.0014)	(0.0014)
H firms in industry_t	-0.0001	-0.0006**	-0.0008***	-0.0009***
	(0.0004)	(0.0002)	(0.0003)	(0.0002)
H firms in region_t	0.0001	0.0025**	0.0029**	0.0032**
	(0.0001)	(0.0012)	(0.0011)	(0.0012)
F investment in industry_t	-0.1845***	-0.0781	-0.0525	-0.0201
	(0.0543)	(0.0504)	(0.0408)	(0.0343)
F investment in region_t	0.0251	0.0395	0.0133	0.0199
	(0.0746)	(0.0551)	(0.0347)	(0.0345)
H investment in industry_t	-0.2067	0.0211	-0.2220**	-0.1327
	(0.2177)	(0.1461)	(0.1043)	(0.0935)
H investment in region_t	0.0005	0.5281*	0.7639***	0.8121*
	(0.0509)	(0.2818)	(0.2865)	(0.2807)
Sargan test			0.089	0.089
AR(1)			-6.091***	-5.685***
AR(2)			-0.1647	-0.1717
N. Obs.	6009	5244	3545	3545

Note. (i) Dependent variable: log of export; all independent variables with the exception of numbers of H/F firms in region/industry are in log form, (ii) all equations include industry dummies, time dummies and a constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) AR(2) is the Arellano-Bond test for second order autocorrelation, (vii) all estimations calculated using DPD package for Ox.

Table 6: GMM estimations for durable and non-durable goods producers.

	durable		non-durable	
	one-step	two-step	one-step	two-step
Independent variable	(1)	(2)	(3)	(4)
$Export_{t-1}$	0.0546	0.0224	0.1336**	0.1290
	(0.0475)	(0.0643)	(0.0626)	(0.0696)
$Labor_t$	0.4297	0.3866	0.7380***	0.6364***
	(0.4226)	(0.4464)	(0.1525)	(0.1571)
F firms in $industry_t$	0.0130**	0.0109	0.0008	-0.0007
	(0.0063)	(0.0072)	(0.0045)	(0.0044)
F firms in $region_t$	0.0052**	0.0080***	0.0022	0.0036
	(0.0022)	(0.0023)	(0.0022)	(0.0026)
H firms in $industry_t$	-0.001***	-0.001***	0.0001	0.0000
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
H firms in $region_t$	0.0027	0.0049**	0.0005	0.0014
	(0.0020)	(0.0019)	(0.0017)	(0.0021)
Sargan test	0.140	0.140	0.299	0.299
AR(1)	-3.401***	-3.007***	-5.262***	-4.520***
AR(2)	-0.2261	-0.2177	-1.563	-1.540
N. Obs.	1469	1469	1219	1219

Note. (i) Dependent variable: log of export; all independent variables with the exception of numbers of H/F firms in region/industry are in log form, (ii) all equations include industry dummies, time dummies and a constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) AR(2) is the Arellano-Bond test for second order autocorrelation, (vii) all estimations calculated using DPD package for Ox.

Table 7: GMM estimations for small and large firms.

	small		large	
	one-step	two-step	one-step	two-step
Independent variable	(1)	(2)	(3)	(4)
$Export_{t-1}$	-0.159***	-0.154***	0.0080	0.0446
	(0.0546)	(0.0565)	(0.0634)	(0.0417)
$Labor_t$	0.5525	0.8980*	2.1450***	1.7116***
	(0.3797)	(0.4950)	(0.4467)	(0.4217)
F firms in $industry_t$	0.0075	0.0094	0.0174**	0.0179**
	(0.0056)	(0.0058)	(0.0084)	(0.0077)
F firms in $region_t$	0.0013	0.0034	0.0133***	0.0126***
	(0.0032)	(0.0037)	(0.0027)	(0.0027)
H firms in $industry_t$	-0.0008	-0.0008	-0.0007*	-0.0006*
	(0.0006)	(0.0007)	(0.0004)	(0.0003)
H firms in $region_t$	0.0016	0.0024	0.0074***	0.0079***
	(0.0028)	(0.0040)	(0.0020)	(0.0020)
Sargan test	0.755	0.755	0.384	0.384
AR(1)	-2.645***	-2.558***	-3.182***	-3.749***
AR(2)	-0.2365	-0.1926	-1.209	-1.095
N. Obs.	439	439	1059	1059

Note. (i) Dependent variable: log of export; all independent variables with the exception of numbers of H/F firms in region/industry are in log form, (ii) all equations include industry dummies, time dummies and a constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) AR(2) is the Arellano-Bond test for second order autocorrelation, (vii) all estimations calculated using DPD package for Ox.

Table 8: GMM estimations for urban and non-urban firms.

	urban		non-urban	
	one-step	two-step	one-step	two-step
Independent variable	(1)	(2)	(3)	(4)
$Export_{t-1}$	0.125***	0.102**	0.033	0.0399
	(0.0470)	(0.0518)	(0.0459)	(0.0488)
$Labor_t$	0.9341***	0.9804***	0.9844***	0.8817***
	(0.1834)	(0.1819)	(0.1594)	(0.1703)
F firms in $industry_t$	0.0127***	0.0104***	0.0125**	0.0186**
	(0.0034)	(0.0034)	(0.0059)	(0.0089)
F firms in $region_t$	0.0035*	0.0039*	0.0101***	0.0110***
	(0.0019)	(0.0021)	(0.0035)	(0.0036)
H firms in $industry_t$	-0.0007**	-0.0007**	-0.001***	-0.0006*
	(0.0003)	(0.0003)	(0.0004)	(0.0003)
H firms in $region_t$	0.0018	0.0019	0.0069***	0.0076***
	(0.0016)	(0.0018	(0.0023)	(0.0024)
Sargan test	0.602	0.602	0.068	0.068
AR(1)	-5.407***	-4.867***	-4.320***	-4.144***
AR(2)	-0.4248	-0.4207	-0.013	0.0000
N. Obs.	1670	1670	2007	2007

Note. (i) Dependent variable: log of export; all independent variables with the exception of numbers of H/F firms in region/industry are in log form, (ii) all equations include industry dummies, time dummies and a constant, (iii) heteroscedastic consistent standard errors in brackets, (iv) *** denotes significant at the 1%, ** at the 5%, * at the 10% level, (v) instruments include some or all available moment restrictions of the endogenous explanatory variables, (vi) AR(2) is the Arellano-Bond test for second order autocorrelation, (vii) all estimations calculated using DPD package for Ox.